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I, SMILJA DRAGOSAVLJEVIC, TEAM LEADER EXAMINATION SUPPORT AND SALES hereby certify that annexed is a true copy of the Provisional specification in connection with Application No. 2002951162 for a patent by UNIVERSITY OF WESTERN SYDNEY as filed on 02 September 2002.

WITNESS my hand this
Twenty-first day of March 2003

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Patents Act 1990

PROVISIONAL SPECIFICATION

Applicant(s):

UNIVERSITY OF WESTERN SYDNEY

Invention Title:

CONNECTOR ELEMENT

The invention is described in the following statement:

CONNECTOR ELEMENT

The present invention relates to connector elements that can be used with connectors for attaching concrete bodies to structural components, for example in columns and beams.

In one form, the present invention relates to connector elements that can be used with shear connector studs that form the main connection between a concrete slab and a framework.

Australian provisional application PS1059 in the name of the applicant discloses a connector assembly for connecting a concrete body to a structural component wherein the connector assembly is capable of resisting shear forces between the structural component and the concrete body and includes:

(a) a connector having a shank with one end adapted to be embedded in concrete and the other end adapted to be attached to the structural component; and

(b) a connector element that is adapted to surround the connector and form a barrier that is spaced from the connector and confines concrete around the connector.

Australian provisional application PS1059 also discloses a composite concrete structure that includes a concrete body connected to a structural component by way of a connector assembly, which connector assembly includes:

(a) a connector having a shank with one end embedded in the concrete body and the other end attached to the structural component; and

(b) a connector element that surrounds the connector and forms a barrier that is spaced from the connector and confines concrete around the connector.

Australian provisional application PS1059 also discloses a composite structure that includes concrete supported by a decking on a structural framework and a plurality of connectors in the form of shear connectors connecting the composite structure to the structural framework, each connector including at least one stud fixed upright to the decking and the structural framework, and a connector element placed on the decking and forming a barrier that surrounds at least one stud a spaced distance therefrom and confines concrete around the stud.

Australian provisional application PS3098 in the name of the applicant discloses a clip for use with the above-described connector assembly. The purpose of the clip is to facilitate locating the connector element in relation to the connector. This is a particularly important issue in the difficult working environment in which the connector assemblies are generally used.

In general terms, the clip disclosed in Australian provisional application PS3098 includes:

(a) a means for coupling the clip to an upper section of the connector element, and

(b) a plurality of legs formed from resilient material that extend inwardly and have inner ends that describe a circular opening that can receive the shank of the connector, and which opening has a diameter that is less than that of the shank, whereby in use the legs deflect when the clip is pushed downwardly over the shank so that the shank extends through the opening and the

inner ends of the legs contact the shank and thereby couple the clip to the shank.

The disclosure in Australian provisional applications PS1059 and PS3098 is incorporated herein by cross-reference.

The applicant has realised that is possible to integrally form the above-described connector element and clip and that considerable advantages can be achieved with this combination.

The present invention provides a connector element for use in a connector assembly for connecting a concrete body to a structural component wherein the connector assembly is capable of resisting shear forces between the structural component and the concrete body.

The connector assembly includes the connector element and a connector having a shank with one end adapted to be embedded in concrete.

The connector element of the present invention includes:

(a) a barrier section to confine concrete around the connector, and

(b) an integrally formed clip assembly for coupling the connector element, and more particularly the barrier section, to the connector.

Preferably the clip section includes a plurality of legs formed from resilient material that extend inwardly from an upper section of the barrier section and have inner ends that describe an opening that can receive the shank of the connector and have a diameter that is

less than that of the shank, whereby in use the legs deflect when the connector element is pushed downwardly over the shank so that the shank extends through the opening and the inner ends of the legs contact the shank and thereby couple the connector element to the shank with the barrier section positioned to surround the shank.

The above-described connector element can be effectively locked to the shank of the connector.

Preferably the legs are formed so that the legs can flex vertically when in use the connector element is pushed downwardly over the shank to locate the connector element on the shank.

Preferably the legs are formed so that the legs can flex vertically and horizontally when in use the connector element is pushed downwardly over the shank to locate the connector element on the shank.

Preferably at least one of the legs includes an upward crank.

The cranked end facilitates guiding the connector element onto the shank.

In addition, the cranked end facilitates initially locating the connector element in the correct orientation in relation to the shank. Specifically, the cranked end provides an obvious visual indication of the correct orientation of the connector element, and more particularly the clip section of the connector element, in relation to the shank.

In addition, the cranked end increases resistance to upward movement of the connector element after it has been located on the shank. Specifically, upward movement

tends to cause the upwardly cranked end or ends to dig into the shank and thereby increase resistance to further upward movement.

Preferably the leg or legs that include the cranked end further include a first leg section that is formed to increase the flexibility of the leg.

The first leg section reduces the downward force required to push the connector element downwardly over the shank to locate the connector element on the shank and makes it possible to control the bending stresses in the legs, thereby preventing yielding of the legs. Yielding of the legs is unsatisfactory because it prevents good engagement of the connector element, and more particularly the clip section of the connector element, onto the shank.

Preferably the section is in the form of a curved bend in the leg outwardly of the cranked end.

Preferably the inner ends of the legs are relatively wide to enable the legs to grip the shank securely.

Preferably the inner ends of the legs include projections that enable the legs to grip the shank securely.

Preferably the legs are formed from spring steel.

Preferably the legs are formed so as to minimise interference to concrete flowing into the volume defined by the connector element that enclose the connector.

Preferably the opening is a circular opening.

According to the present invention there is also

provided a composite concrete structure that includes a concrete body connected to a structural component by way of a connector assembly, which connector assembly includes:

(a) a connector having a shank with one end embedded in the concrete body and the other end attached to the structural component; and

(b) the connector element described above positioned so that the barrier section is spaced from and surrounds the connector and confines concrete around the connector and the clip section couples together the connector element and the connecter.

According to the present invention there is also provided a composite structure that includes concrete supported by a decking on a structural framework and a plurality of connectors in the form of shear connectors connecting the composite structure to the structural framework, each connector including at least one stud fixed upright to the decking and the structural framework, and a connector element placed on the decking and forming a barrier that surrounds at least one stud a spaced distance therefrom and confines concrete around the stud.

According to the present invention there is also provided a method of manufacturing the above-described connector element that includes stamping a flat blank from a steel sheet, the blank having (a) a rectangular section that corresponds to the barrier section 3 and (b) 4 elongate members extending from one side of the rectangle that correspond to the legs of the clip section, folding the rectangular section of the blank to form the barrier section, and shaping the elongate members to form the legs of the clip section.

According to the present invention there is also provided a method of manufacturing the above-described connector element that includes pressing a cup-shaped member from a steel sheet, the cup-shaped member having a cylindrical wall that forms the barrier section, and stamping the base to form the legs of the clip section.

The present invention is described further by way of example with reference to the accompanying drawings of which:

Figure 1 is a vertical cross-section through a preferred embodiment of a connector element in accordance with the present invention, the Figure also showing in outline a connector and illustrating the position of the connector element in relation to the connector in use of these components as a connector assembly; and

Figure 2 is a top plan view of the connector element shown in Figure 1.

The connector element 3 shown in the Figures is intended for use as part of a connector assembly for connecting a component such as a decking sheet to an underlying structure prior to pouring concrete onto the decking and the connector assembly in the construction of a composite concrete structure. In addition to the connector element 3, the connector assembly also includes a connector 4 (partly shown in outline in Figure 1) in the form of a fastener that has a shank (as shown in the Figure) and an enlarged head (not shown). In this application the purpose of the connector element 3 is to increase the ductility and shear strength, and therefore the shear resistance, of the connector 4 by forming a barrier around and thereby confining concrete around the connector 4.

The connector element 3 includes (a) a barrier section 5 and (b) a clip section generally identified by the numeral 7.

The purpose of the barrier section 5 is to confine concrete around the connector 4.

The purpose of the clip section 7 is to facilitate locating the connector element 3 securely in place in relation to the connector 4 before concrete is poured.

The barrier section 5 is in the form of a cylinder or ring.

The clip section 7 includes 4 equally spaced legs 15 extending inwardly from the barrier section 5.

The legs 15 terminate in inner ends 17 that describe a circular opening 19 for receiving the shank of the connector. The diameter of the described opening 19 is selected to be less that that of the shank so that the legs 15 can engage and thereby couple the connector element 3 to the connector 4 when the connector element 3 is positioned onto the shank as shown in Figure 1.

The legs 15 include upwardly inclined sections 21 that define a frusto-conical region around the shank. As is described above, these upwardly cranked sections provide a number of advantages, including facilitating guiding the connector element 3 onto the shank, facilitating initially locating the connector element 3 in the correct orientation in relation to the shank, and increasing resistance to upward movement of the connector element 3 after it has been located on the shank.

The legs 15 also include a downwardly-curved bend

25 between the frusto-conical region and the junction of the legs 15 and the barrier section 5. The bends 25 increases the effective length of the legs 15.

In use, the connector element 3 is located on the shank of the connector 4 by positioning the clip section 7 above the shank with the legs 21 contacting the head (not shown) of the shank and then pushing the connector element 3 down onto the shank.

One option for manufacturing the connector element 3 is to form the connector element 3 from one piece of flat steel sheet. The first step is to stamp a flat blank from the steel sheet, with the blank having (a) a rectangular section (that corresponds to the barrier section 3), and (b) 4 elongate members extending from one side of the rectangle (that correspond to the legs 15 of the clip section 7). The next step is to roll the rectangular section into a cylinder and to join the ends of the rectangle together. The ends could be joined together by means of hook elements 23 formed at one end that are passed through openings (not shown) formed at the other end of the rectangle and are then folded back onto the cylinder. Another, although not the only other, option is to weld the ends together. The final step is to shape the legs 15 into the required configuration, as shown in Figure 1.

Another option for manufacturing the connector element 3 is to press a cup having a base and a cylindrical wall from one piece of flat steel sheet, thereafter stamp the base to form an outline of the legs, and finally shape the legs to the form shown in Figure 1.

In both of the above-described options, the formed connected elements are heat treated to form high tensile spring steel.

It will be understood by a person skilled in the art of the present invention that many modifications may be made without departing from the spirit and scope of the present invention.

By way of example, whilst the preferred embodiment includes 4 legs 15, the present invention is not so limited and extends to connector elements 3 that have any suitable number of legs.

In addition, whilst the preferred embodiment includes radially extending legs 15, the present invention is not so limited and extends to legs that are not radial legs.

In addition, whilst the preferred embodiment includes upwardly inclined sections 21 that define a frusto-conical region around the shank, the present invention is not so limited.

In addition, whilst the preferred embodiment is described in the context of composite concrete structure that includes a decking sheet and a layer of concrete on the sheet and connecting the composite concrete structure to an underlying structural component, the present invention is not so limited and extends to concrete structures generally. For example, the present invention extends to connector assemblies that can be used in relation to concrete footings and the like that are used to support base plates and other structural components. These arrangements typically include connectors in the form of bolts that are embedded in concrete footings and extend from the footings and provide connection points for base plates.

Figure 1

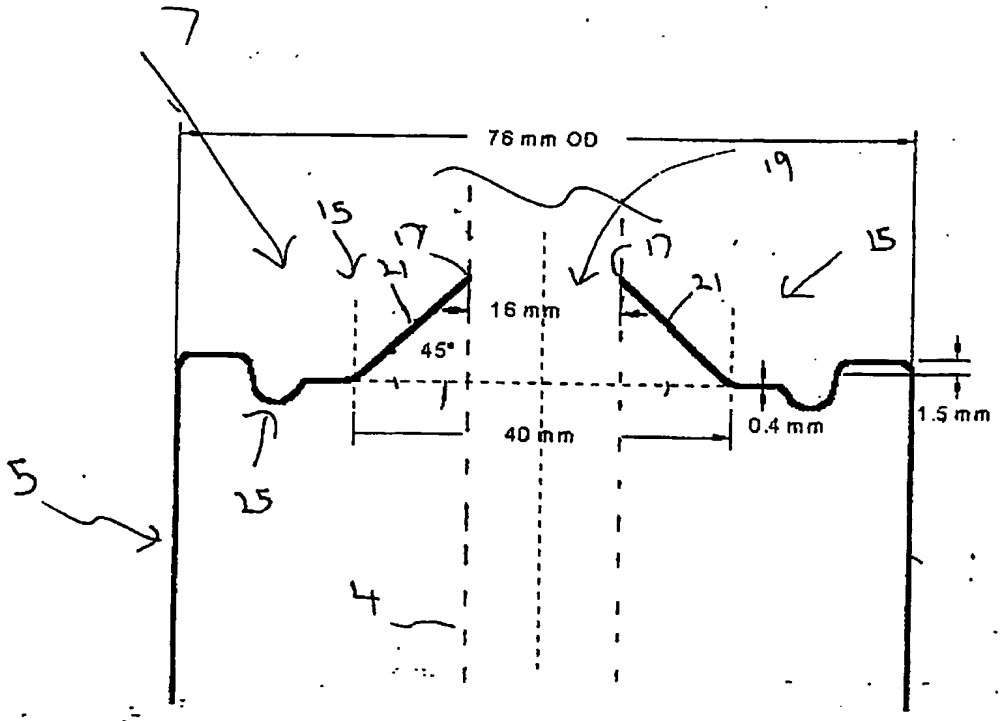

Figure 2